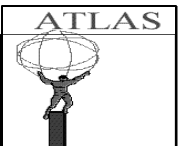


**WBS 1.2.1, 1.2.5**  
**TRT Barrel- Mechanic-**  
**Electronics**  
**H. Ogren**



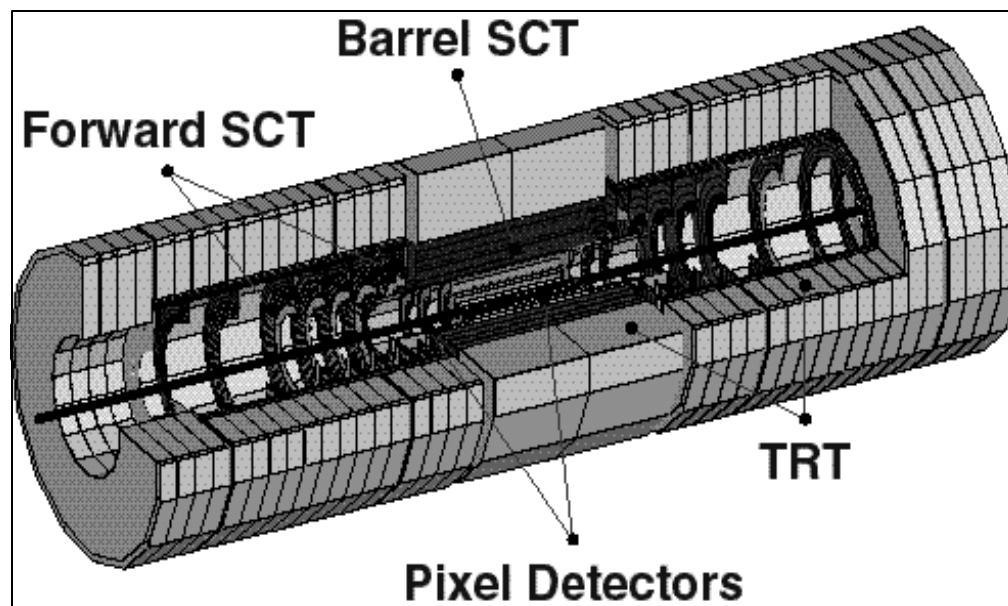
# ATLAS BARREL TRT

## WBS 1.2.1 Module Construction

Duke University  
Indiana University  
Hampton University

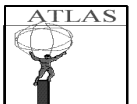
## WBS 1.2.5 Front-end Electronics

University of  
Pennsylvania



# US TRT Barrel Project

- WBS 1.2.1-Module construction:
  - ◆ Procure all parts (except Tension Plate-Lund)
  - ◆ Assemble barrel modules modules and spares
  - ◆ Test and Map module wire locations
  - ◆ Install modules in Barrel support frame
- WBS 1.2.5- Front-end Electronics
  - ◆ Design ASDBLR- (DTMROC) with Lund and CERN
  - ◆ Fabricate the Front-end Electronics (425,000 ASDBLR)
  - ◆ Fabricate and test Printed Circuit boards.(106,000 Endcap)
  - ◆ System tests and Installation of electronics.



# Update on US-Barrel-TRT-2002

## Module Construction

**Module components about 2/3 complete**

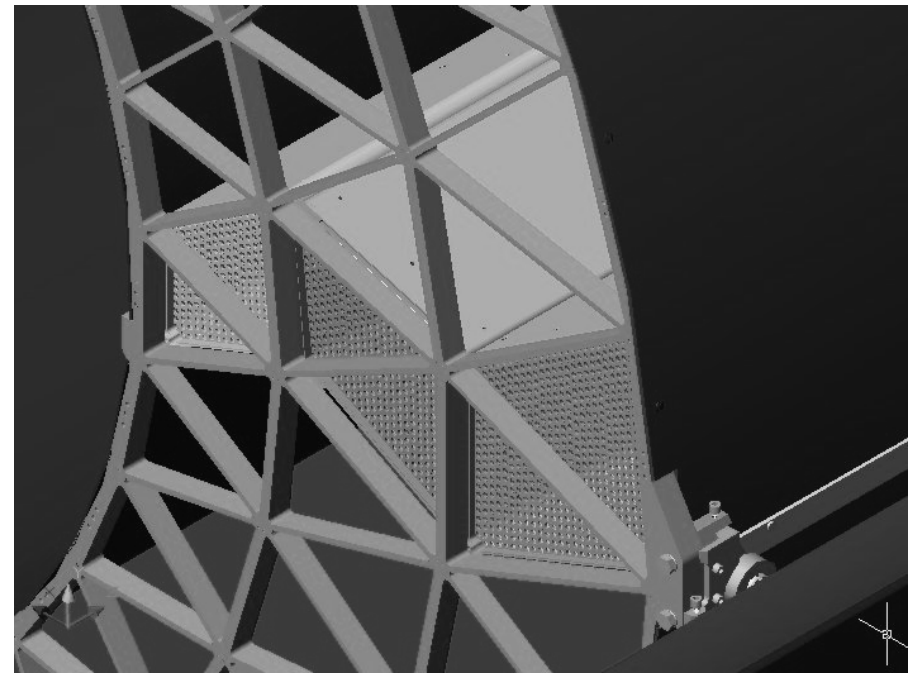
**47 Module completed mechanically**

**27 modules strung, however wire stringing has been paused while we evaluate the wire joint.**

## Front-end Electronics

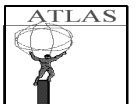
**ASDBLR ready for production  
PRR March 27**

**DTMROC has now been  
produced in DSM**

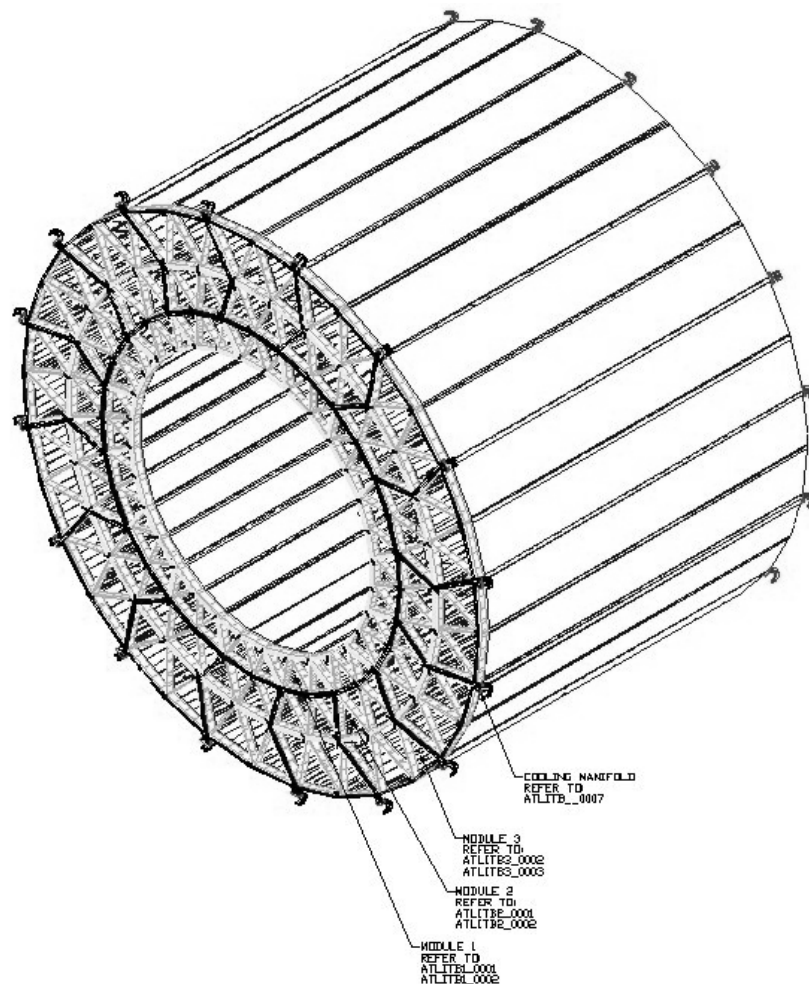
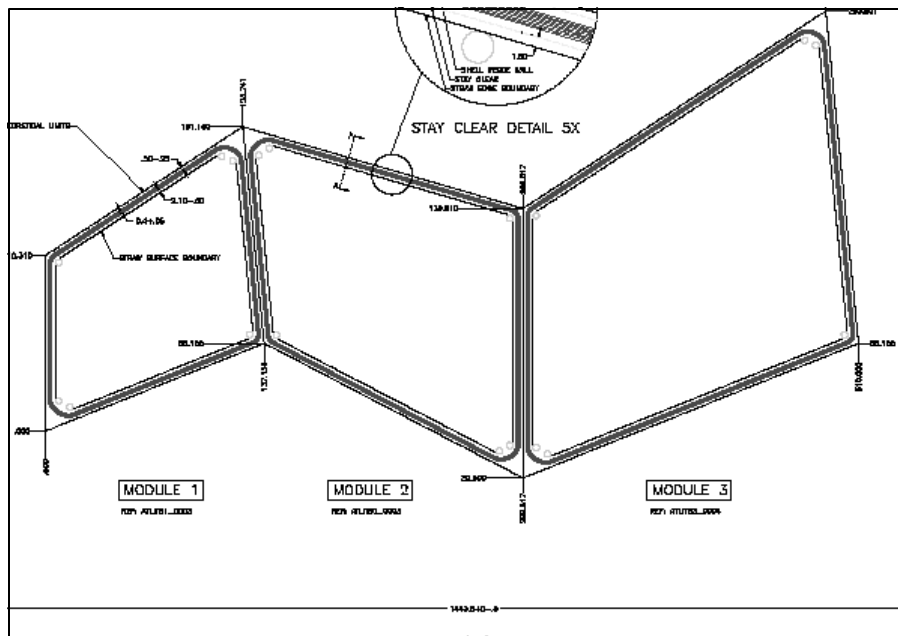


# Outline

- **TRT- Barrel**
  - ◆ **Update on Front-end electronics**
  - ◆ **Update on Barrel mechanics**
- **M&O**
  - ◆ **Mechanics and electronics**



# Three Layers of Barrel



Type 1-----Type 2-----Type3  
M1.32      M2.32      M3.32

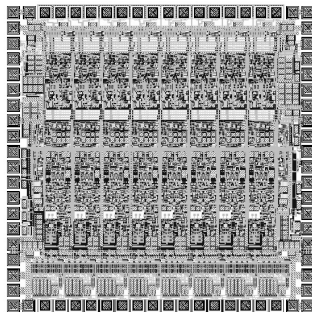
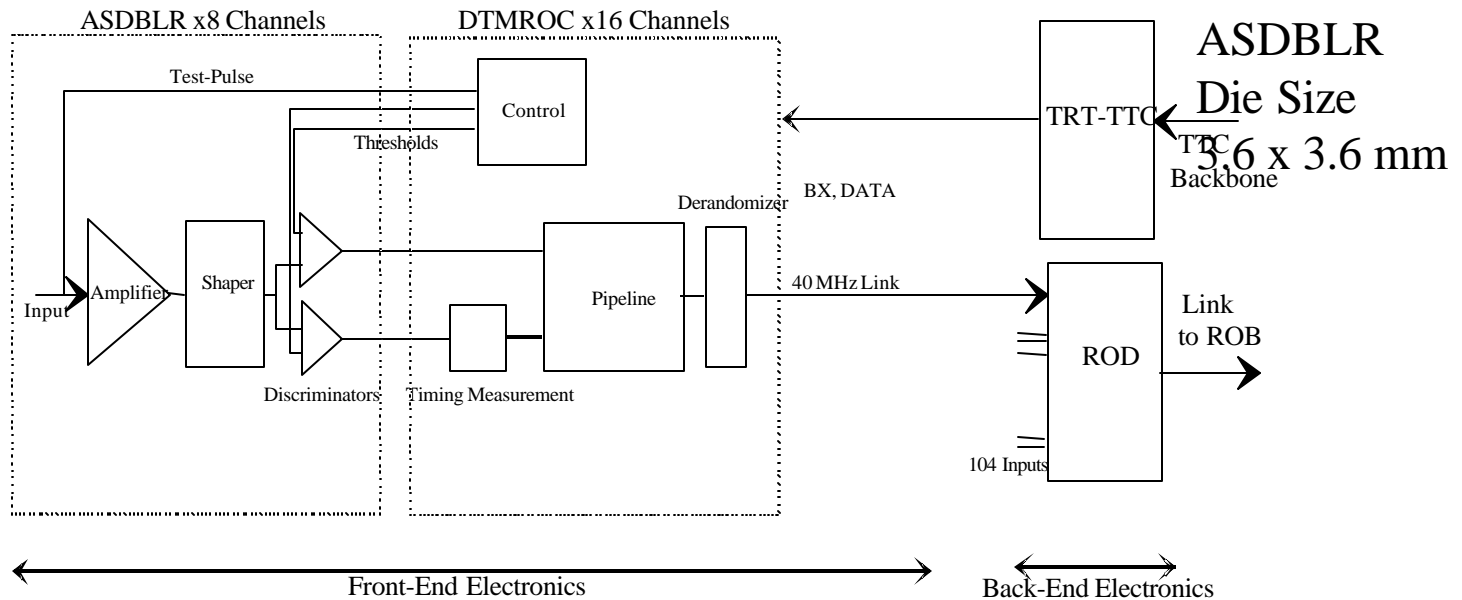
**Type 1 32 \* 329 straws in type 1 =10528**

**Type 2 32\* 520 straws in type2 =16640**

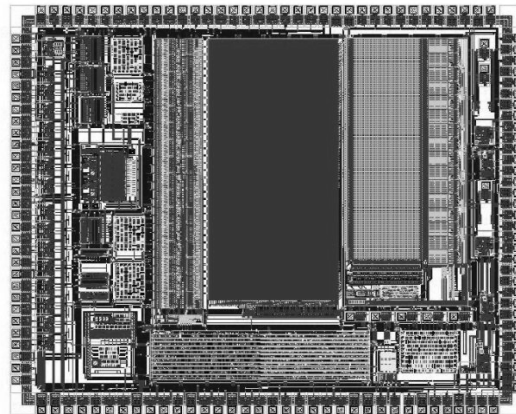
**Type 3 32\* 793 straws in type 3 =25376**

**52544 total straws**

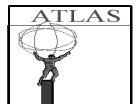
# TRT Electronics Overview



- ASDBLR Die Size
- 3.6 x 3.6 mm



DTMROC Die Size 7.7 x 9.3 mm



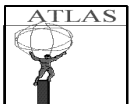
# Front end Electronics

- **Electronics**

- ◆ Production of ASDBLRs –design of DTMROCs
- ◆ System management and engineering of electronics and cabling
- ◆ Construction of electronics front-end boards

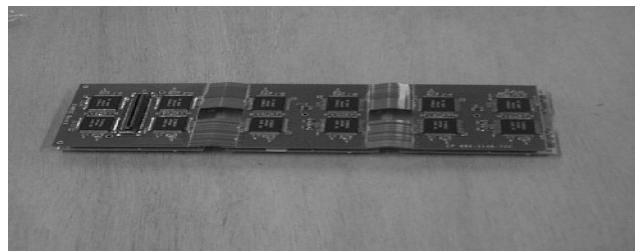
- **Primary M&O responsibilities**

- ◆ Checkout of electronics for front-end and end cap
- ◆ Engineering(grounding, shielding, etc) in preoperations & commissioning and initial operations.
- ◆ Electronics maintenance after assembly and after installation in the detector.
- ◆ General contribution (physicists and technical personnel) to preops, commissioning, operations and maintenance.



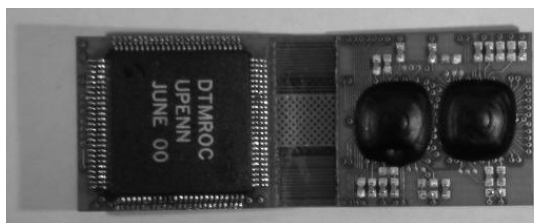
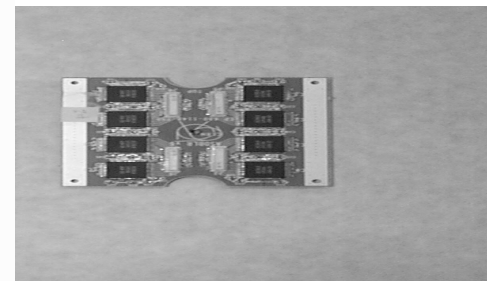
# Front-end Boards

- **End-cap**
  - ◆ 2-layer assembly to define mechanical envelope
  - ◆ 64-channel ASDBLR boards
  - ◆ 192-channel DTMROC board
- **Barrel**
  - ◆ “Postage stamp” boards
  - ◆ Chip-on-board
  - ◆ Flex-boards on hand at Penn, testing started.
  - ◆ 2-3 board stack ready in several weeks

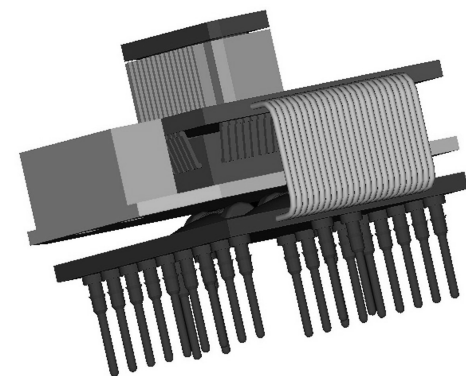


**192-channel  
DTMROC Flex  
board**

**64-channel  
ASDBLR board**



**Flex card - Barrel**



**Flex with cooling  
tab.**



# Recent Electronics Progress - I

- **ASDBLR - Ready for Production**
  - ◆ Revision 01 gives excellent noise performance
  - ◆ Yields with parametric cuts at ~50%
- **DTMROC -**
  - ◆ DMILL01 version ready for production
  - ◆ DMILL yields with parametric cuts ~ 55%
  - ◆ DSM version submitted 17 January 02
  - ◆ DSM two wafers back March 14-processing



# Recent Electronic Progress - II

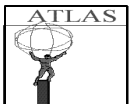
- **Next round radiation ASD test chips were returned and tested in February - OK**
- **PCBS**
  - ◆ **Multiple (old) stamp boards working in test stand at Penn- Snake Cable OK**
  - ◆ **FBGA packaging for Barrel (ASD and DTM) going ahead in Korea**
  - ◆ **New Barrel Stamp Board under review and to go to manufacture this month (FBGA packages)**
  - ◆ **Revisions to End Cap boards ~finished at CERN.**



# Electronics Schedule

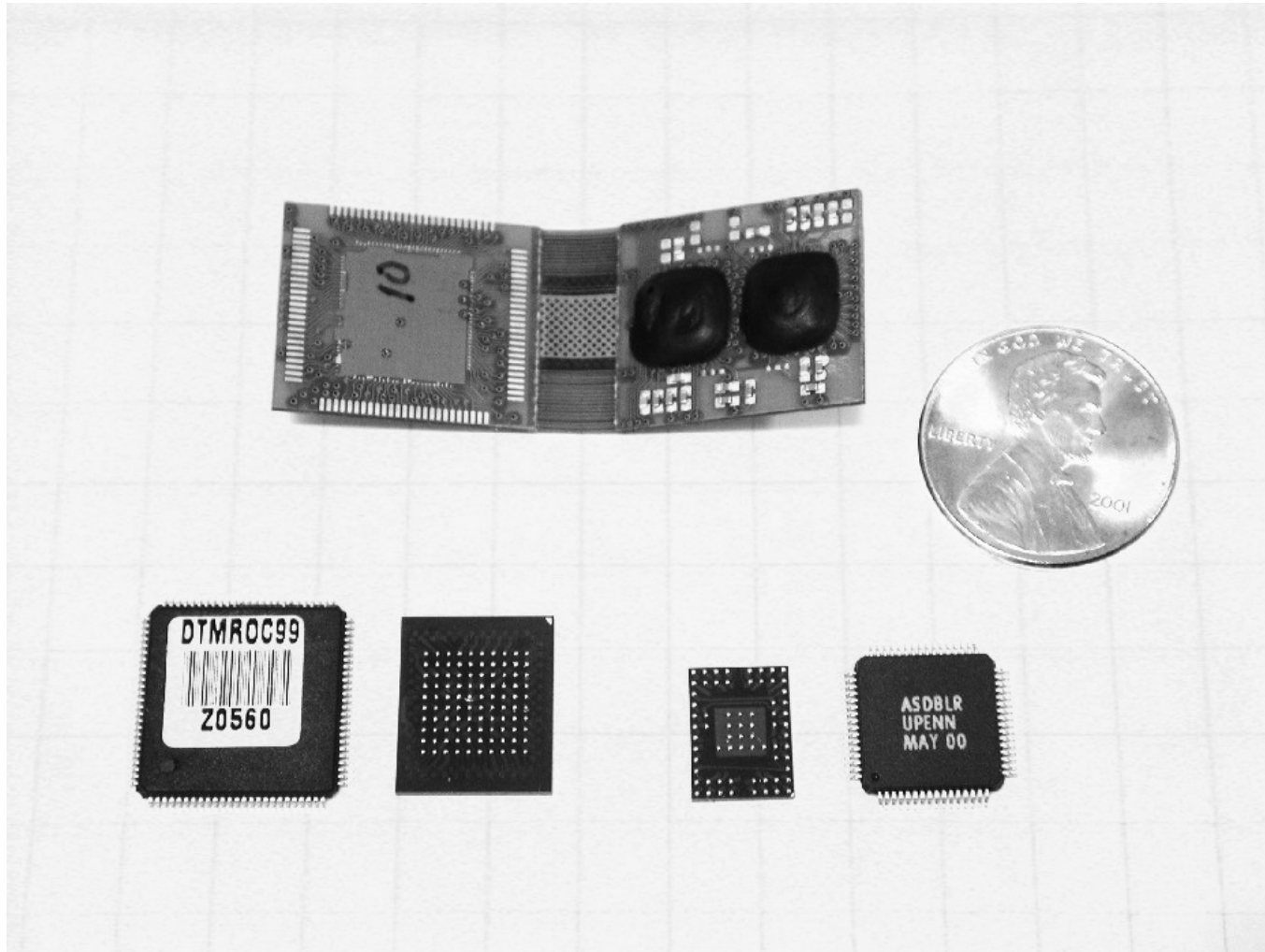
**Chips ready or nearly ready for production**

- **ASDBLR PRR on March 25-26 - finishing documentation**
- **Production schedules much more predictable than development schedules**
- **Barrel PCBs**
  - ◆ **2-3 board stackup- FBGA New boards available end of April.**
  - ◆ **Expect decision by June, 2002, final design by August.**
  - ◆ **Compatible with the new electronics production schedule.**



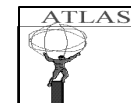
# Flex-board design

## FBGA packaging



# TRT Electronics Schedule

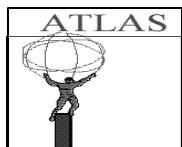
ID	Task Name	Duration	Start	Finish	2002				2003			
					Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4
1	ASDBLR PRR	1 day	Tue 3/26/02	Tue 3/26/02								
2	ASDBLR PreProduction	60 days	Tue 4/9/02	Mon 7/1/02								
3	PreProd Testing	30 days	Tue 7/2/02	Mon 8/12/02								
4	Production Fab	32 wks	Tue 8/13/02	Mon 3/24/03								
5	Production Packaging	18 wks	Tue 12/17/02	Mon 4/21/03								
6	Production Testing	33 wks	Tue 12/31/02	Mon 8/18/03								
7	Production complete	0 days	Mon 8/18/03	Mon 8/18/03								
8	End Cap PCB Prod & Test	36 wks	Tue 2/11/03	Mon 10/20/03								



# TRT Milestones

## Level 2 Milestones

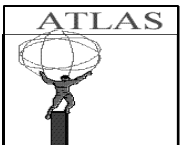
Subsystem	Schedule Designator	Description	ETC 01 Schedule Date	ETC 02 Schedule Date
TRT	TRT L2/1	Final Design Complete	Complete	Complete
	TRT L2/2	Module Production Complete (Cum 102)	31-Mar-03	1-May-03
	TRT L2/3	Barrel Construction Complete	16-Sep-03	16-Sep-03
	TRT L2/4	Select Final Elec Design	31-Aug-01	Complete
	TRT L2/5	Start Production of ASICS	18-Jan-02	9-Jul-02
	TRT L2/6	Installation Complete	4-Jan-05	4-Jan-05



# TRT Milestones

## Level 3 Milestones (Goals)

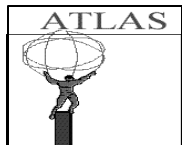
Subsystem	Schedule Designator	Description	ETC 01 Schedule Date	ETC 02 Schedule Date
TRT	TRT L3/1	Barrel Mechanics (Cum 102)	31-Mar-03	1-May-03
	TRT L3/2	ASDBLR	13-Dec-02	18-Mar-03
	TRT L3/3	PCB-Endcap	11-Apr-03	11-Apr-03



# TRT Milestones

## Level 4 Milestones (Baseline Scope)

WBS	Schedule Designator	U.S. ATLAS Responsibility Completion Description	ETC 01 Planned Completion Date	ETC 02 Baseline Scope Completion Date	ATLAS Required Date	ETC 02 Planned Float (Months)
<b>TRT</b>						
1.2.1	TRT L4/1	Barrel Modules Ship to CERN Compl (CUM 69)	8/02	6/03	7/03	1
1.2.5	TRT L4/2	ASDBLRs Ship to LUND Compl	10/02	12/02	6/03	6
	TRT L4/3	ASDBLRs Ship to CERN Compl	11/02	3/03	6/03	3
	TRT L4/4	PCB-Endcaps Ship to CERN Compl	4/03	4/03	7/03	3



# ETC02 Cost Profile

## TRT – WBS Level 3

### TRT ETC 02 Access Profile (Project K\$s)

#### WBS

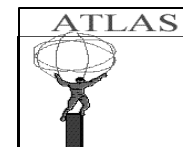
121 Barrel Mechanics

125 Electronics

1.2 Total (FY02\$s)

1.2 Total (AY\$s)

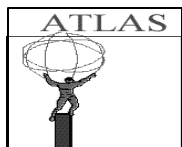
FY01	FY02	FY03	FY04	FY05	FY06	Total
	1,978.1	188.2				2,166.3
	1,268.0	225.7	183.6	102.1		1,779.3
0.0	3,246.1	413.9	183.6	102.1	0.0	3,945.6
0.0	3,246.1	425.5	194.0	111.0	0.0	3,976.5



# ETC02 Cost Comparison

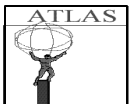
## TRT – WBS Level 3

(Project AYk\$s)			
	Baseline Budget (ETC01 FY02-FY05 + Carryover)	Final ETC02 (FY02-FY05)	
<b>WBS</b>	<b>Budget (AYk\$s)</b>	<b>ETC Budget (AY\$s)</b>	<b>Delta</b>
<b>121 Barrel Mechanics</b>	2,050.6	2,171.5	(120.9)
<b>125 Electronics</b>	1,684.9	1,806.0	(121.1)
<b>Total</b>	3,735.5	3,977.5	(242.0)



# ETC Cost Comments

- **ETC02 exceeds ETC01 by \$120 k ( $120\text{k}/3\text{M} = 4\%$ )**
  - ◆ **NREs for FBGA packages and test sockets (full custom designs to get required density) ~ 60k**
  - ◆ **Extra metalization run with ATMEL to solve noise problem ~42k**
  - ◆ **Add eight wafers to preproduction run to advance early board production ~24k**
  - ◆ **Other minor + and - charges**



# Management Contingency

- **Four Items in MC**

Critical

- ◆ **35% of ASDBLR production- \$246K**

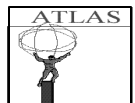


- ◆ **Common Electronics Contribution**

- ◆ **Installation and Commissioning manpower**

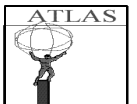
- ◆ **BCP submitted for 25% of DTMROC production**

- ◆ **Depends on success of DSM**



# ETC02 Summary

- **Cost to complete increased by \$120K.**
- **First Management contingency requests is timed to the PRR on the ASDBLR ( March 26, 2002)**



# TRT Barrel Production

## ◆ Update on Barrel mechanics

- Deliverables- 96 barrel modules

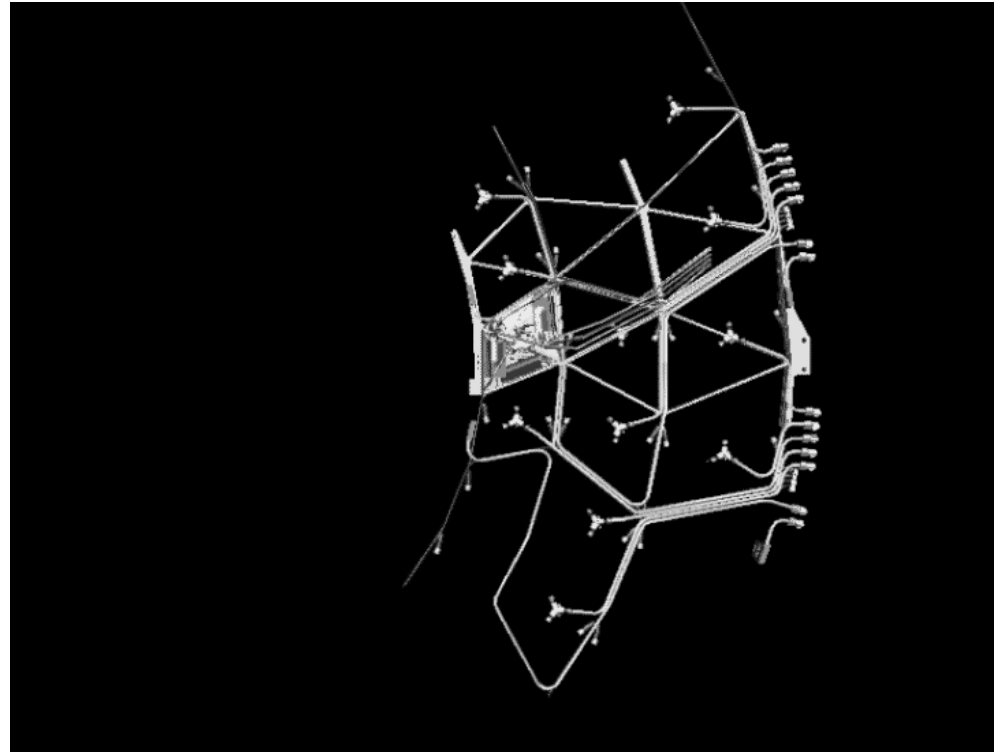
**Modules starts**

**(March 1)**

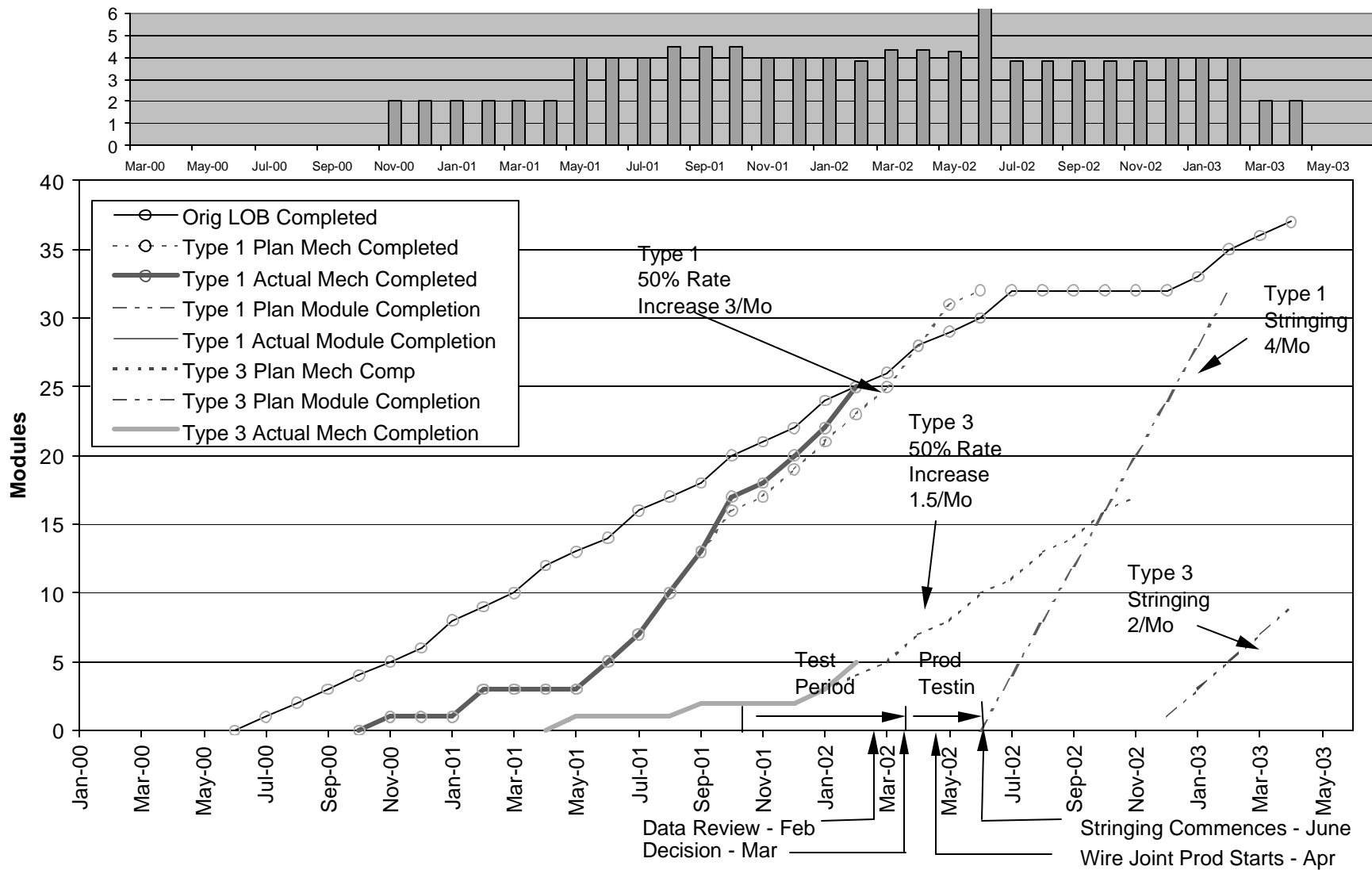
**Type 1 29/32 Modules**

**Type 2 19/32 Modules**

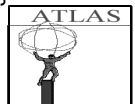
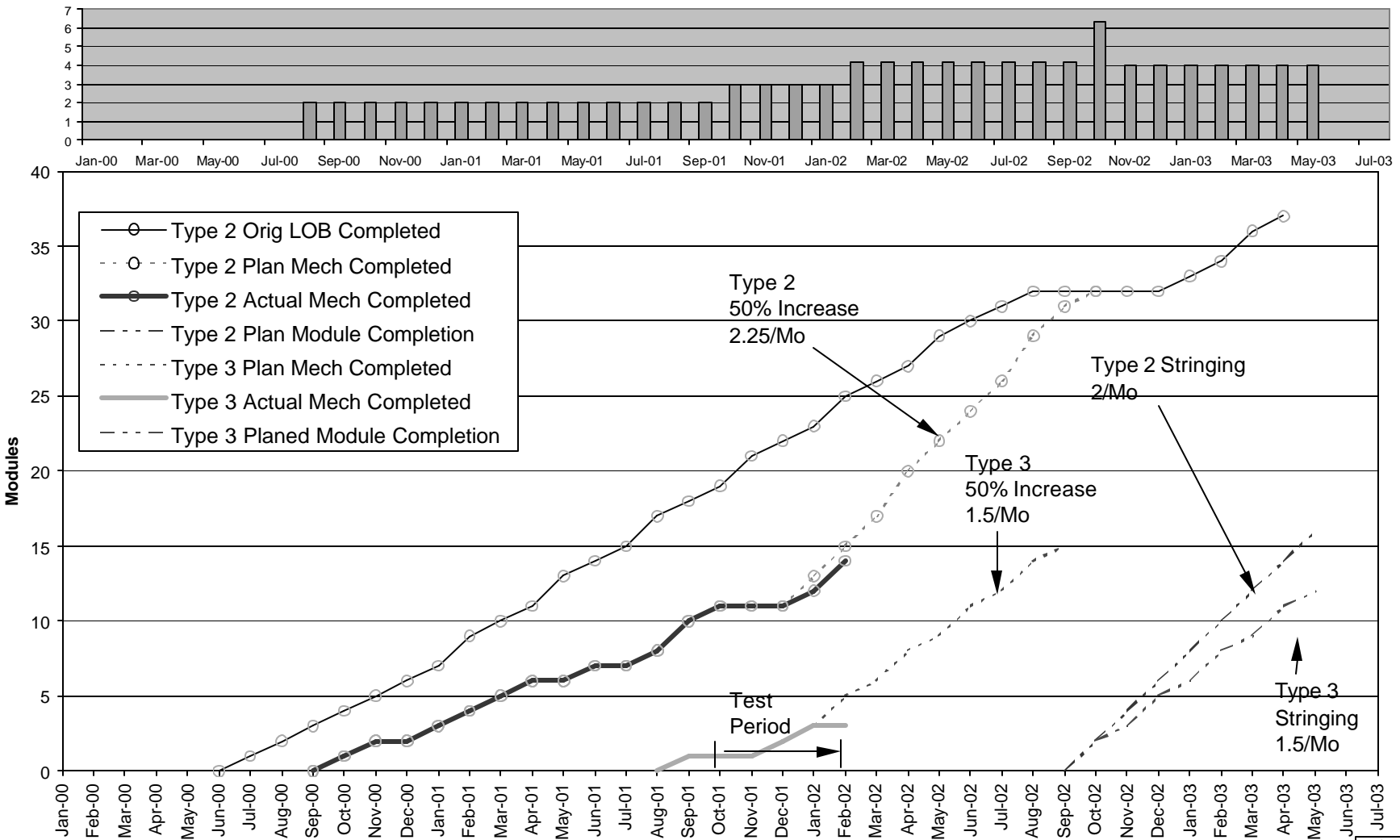
**Type 3 15/32 Modules**



# Module Production - Indiana Facility Plan A

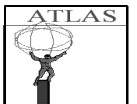


## Module Production - Duke Facility Plan A



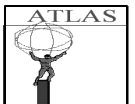
# Barrel TRT Production

- **Due to wire joint failures, wire-joint production (Duke) and wire stringing (Duke and Indiana) has paused since the end of October, 2001.**
- **20% of the barrel module wires had been strung.**
- **Production of unstrung modules and of components for these modules has been accelerated to effectively use the assembly crews.**
- **Activities at Duke/Hampton/Indiana have been rearranged (e.g. Hampton will start operating a wire-stringing station for training of operators and additional wire-stringing stations will be assembled at Indiana from existing components. Radiator production has been moved to Indiana to allow higher straw rate at Hampton.**
- **A new production plan in terms of schedule and human resources has been completed.**



# History

- The glass wire joint had been identified as a critical component early on. Radiation hardness in terms of integral dose had been checked and a validation (apparently insufficient) within an operational straw had been completed at Duke in 1999.
- Ageing studies have a long history in TRT:
  - ◆ wire ageing was “solved” about one year ago (  $\text{CF}_4$  is an important cleaning agent, but it is important but water content of gas must be less than 1000 ppm.)
  - ◆ silicon polymerization problem appeared about one year ago (under low dose rate only, but linked to  $\text{CF}_4$ ) At that time the importance of eliminating sources of silicon became clear and aging tests of a straw with a glass joint became urgent and were emphasized at the PAR in June, 2001, resulted in the Duke tests.



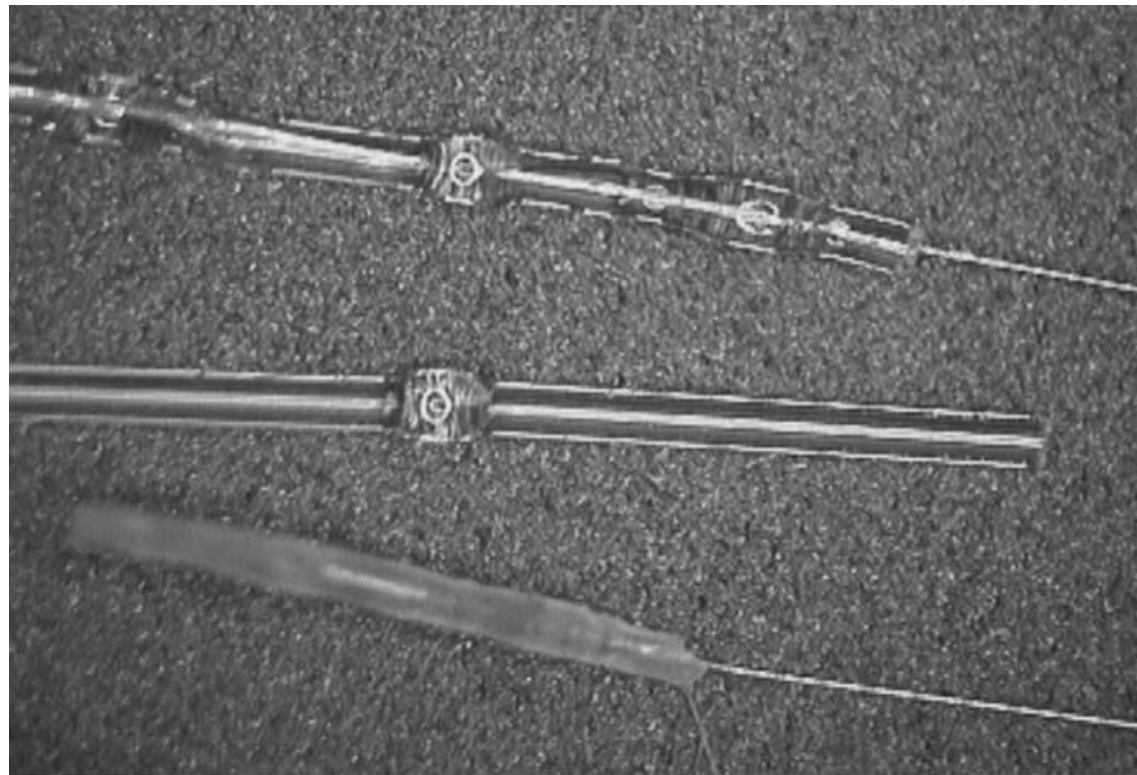
# TRT Barrel Wire Joint Problem

Three wire joints are shown in the figure.

Top object is a normal glass joint.

The middle object is the glass tube(fused at the center) used to make wire joints.

The bottom object is wire joint after irradiation in Xe-CO<sub>2</sub>-CF<sub>4</sub> at high dose rate for an integrated charge corresponding to about 1 month of high-luminosity operation:  
much of the glass has been etched away

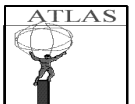


- The barrel wire-joint is a glass tube of about 6 mm length and 0.3 mm diameter. It electrically separates the barrel wire into two halves of ~ 75 cm length

# **Actions to solve the problem**

**After the report from Duke in October, 2001 two parallel approaches were adopted immediately:**

- **Look for replacement material and design for wire joint**
  - **Three designs appear feasible: Addition of a very thin sleeve that encapsulates the glass joint, A PEEK tube that replaces the glass capillary, and polyimide epoxy joint. All three are being actively studied.**
- **Investigate alternate (no CF<sub>4</sub>) gas mixture- Xe-CO<sub>2</sub>, 65/35)**
  - **This was already under investigation because of potential problems with accumulation of CF<sub>4</sub> radicals and silicon products in a closed-circuit gas system.**
  - **Verification that the glass joint survives 4C/cm irradiation will be completed in several months, however a full validation of binary gas mixture for all TRT operations (operational stability, streamers, higher occupancy, signal shaping, ageing studies ...) may take longer.**



# Decision times

**A technical review document was completed on Feb 6, 2002**

**<http://edms.cern.ch/document/336183/1>**

**A joint video conference of ATLAS management, TC, US-ATLAS management, and the US TRT institutions on Friday Feb 8, 2002.**

**On March 25, a selection of the prime wire joint replacement will be made or switch to a binary gas. At that time all joint candidates will have been tested to  $\sim 2$  C/cm- for mechanical or aging effects.**

**Production tooling will then be accelerated, and production quality wire joints will be produced for a decision no later than May 24 the TRT steering group meeting at Hampton. Tests at that time will reach  $>4$  C/cm, also a minimum requirement for a change of gas. The date will be chosen to recommence module wire stringing- probably in mid-June.**

**The fall-back position is to switch to a binary gas. We will have data on the survival of the glass joint in a Binary mixture at that time to  $\sim 4$  C/cm, and experience with the operation of a test chamber at high rates.**

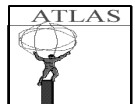
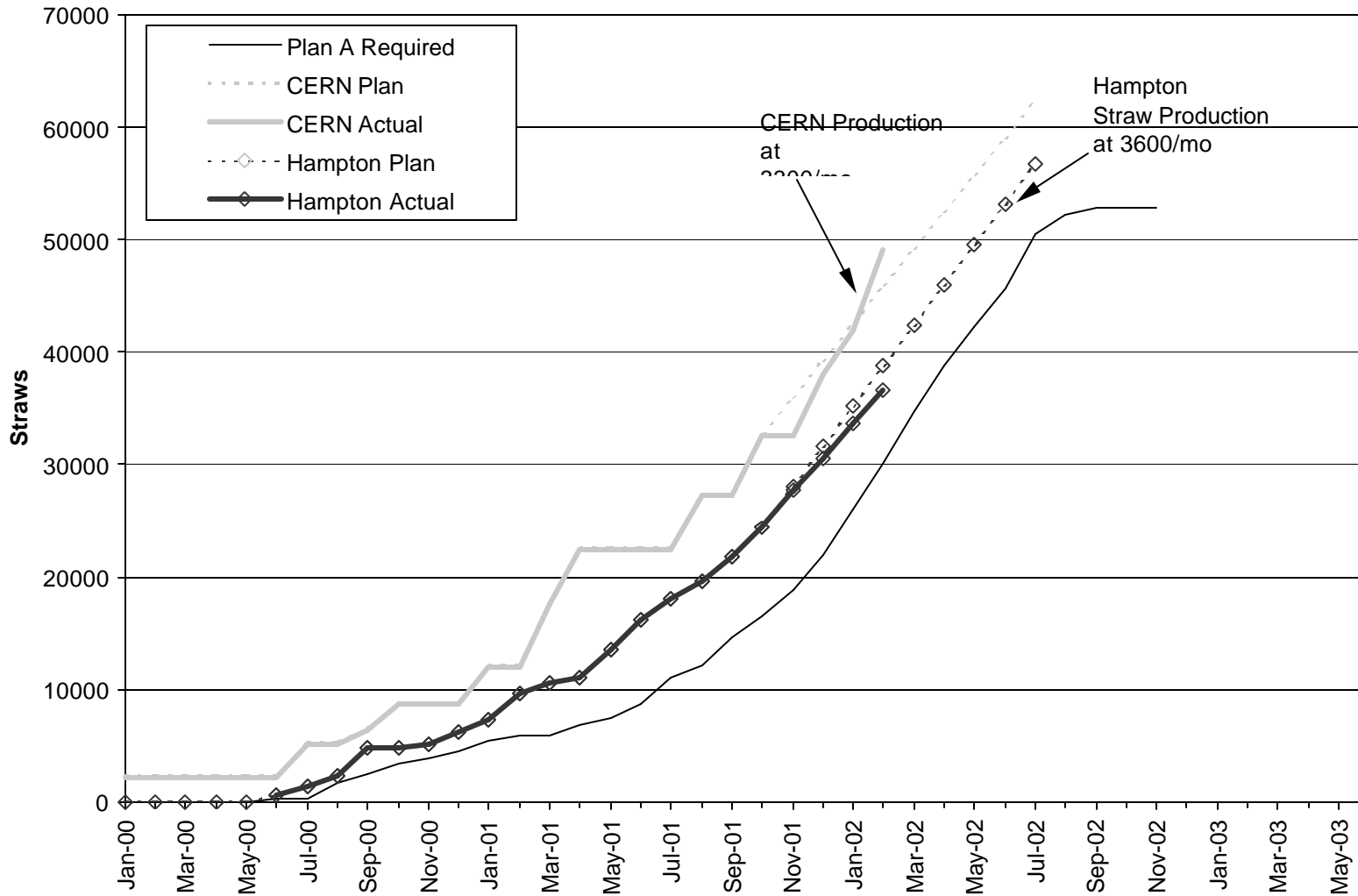


# Production of components

- **Schedule for assembly of all sub components is sufficient to meet the increased module assembly.**
- **Straws**
- **HV Plates**
- **Shells**
- **Radiator**
- **Small plastic parts.**

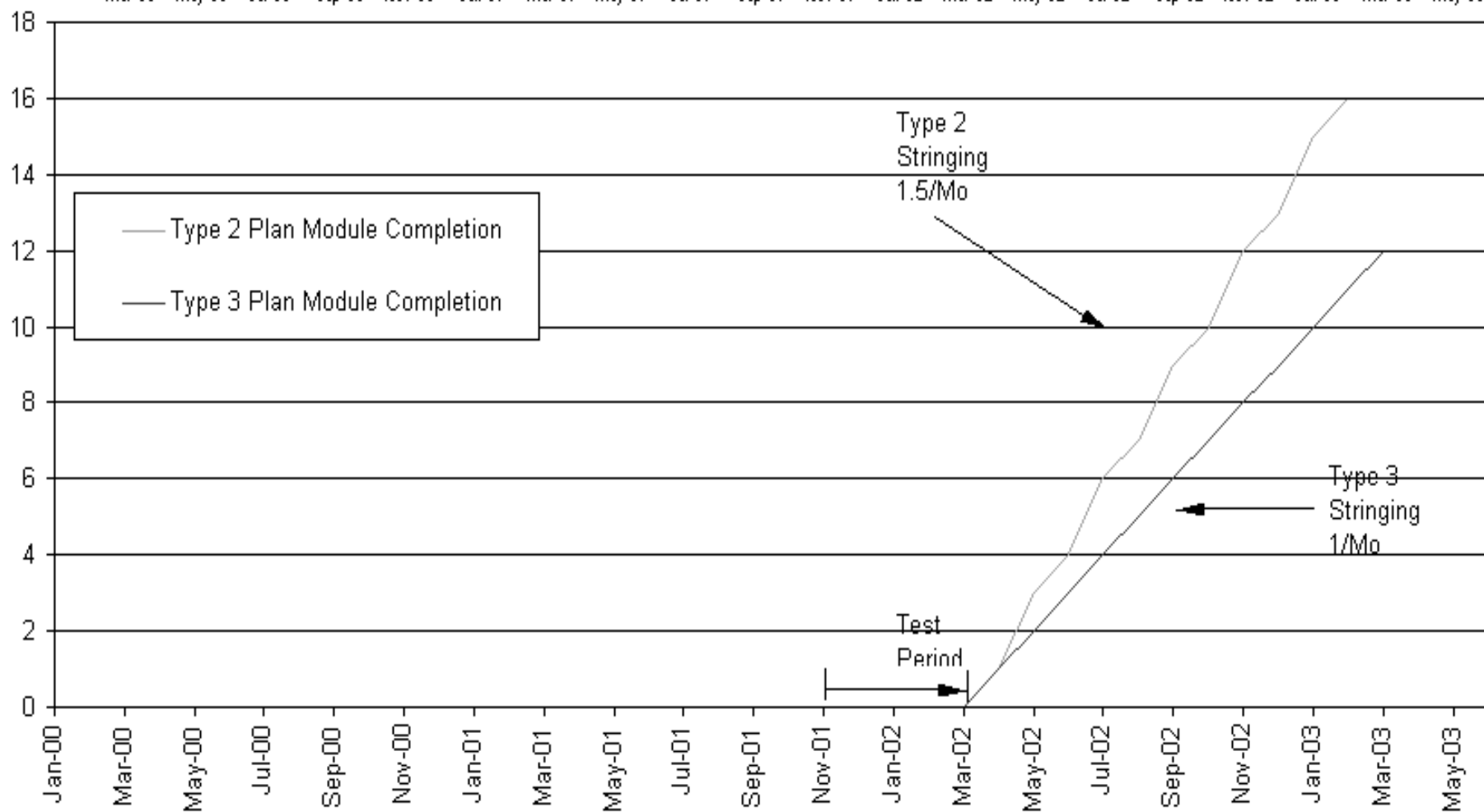
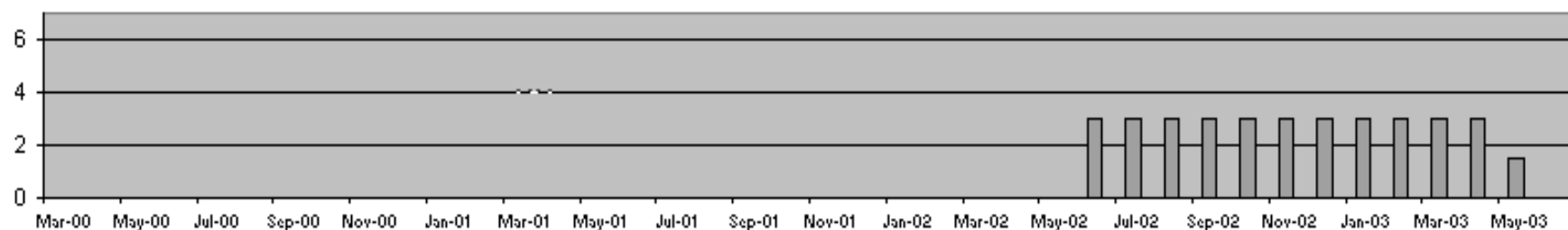


# Straw Production Plan A



# Module Production - Hampton Facility

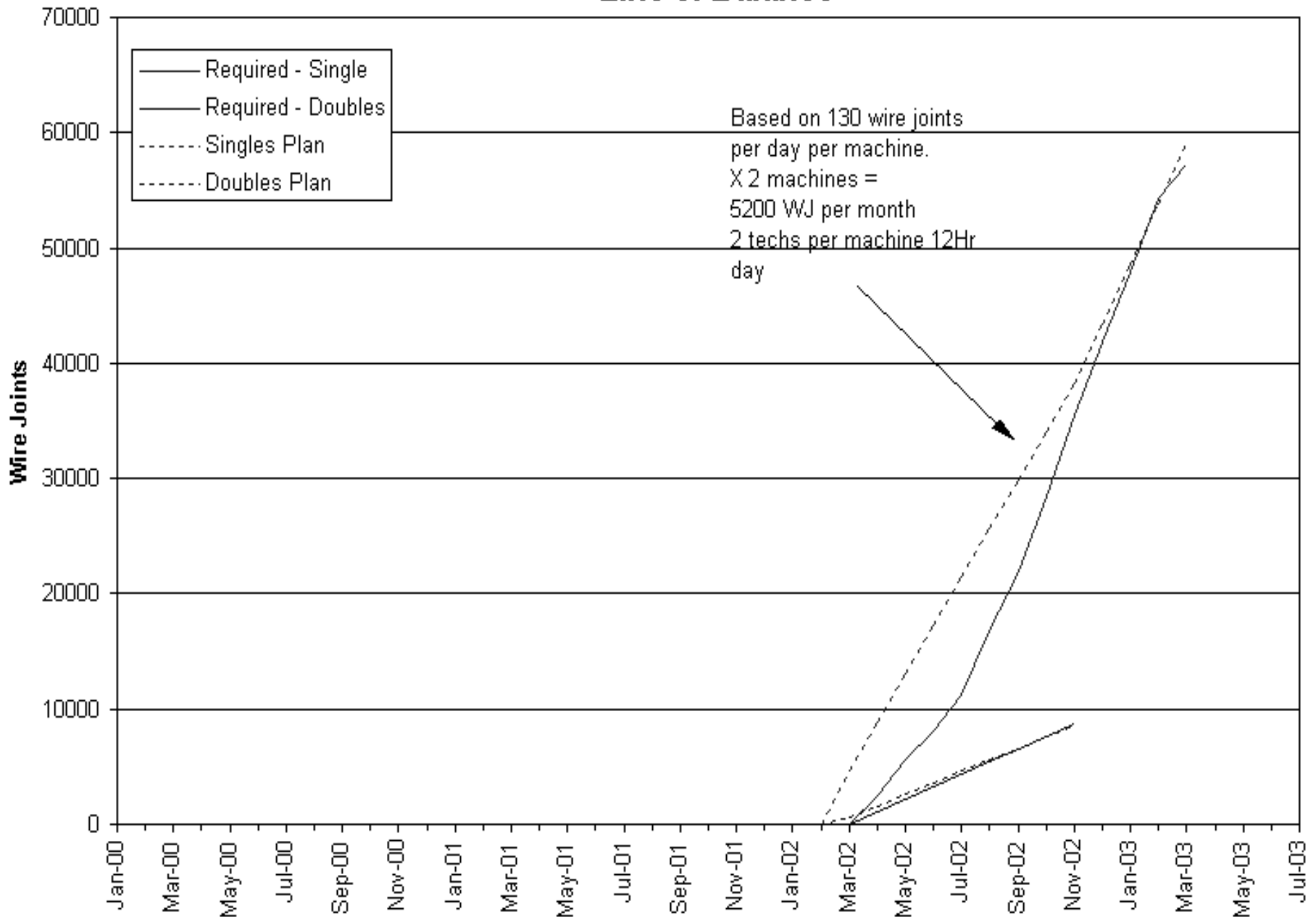
## Line of Balance



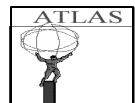
# TRT Wire Joint Production

## Re-Stringing Option

### Line of Balance

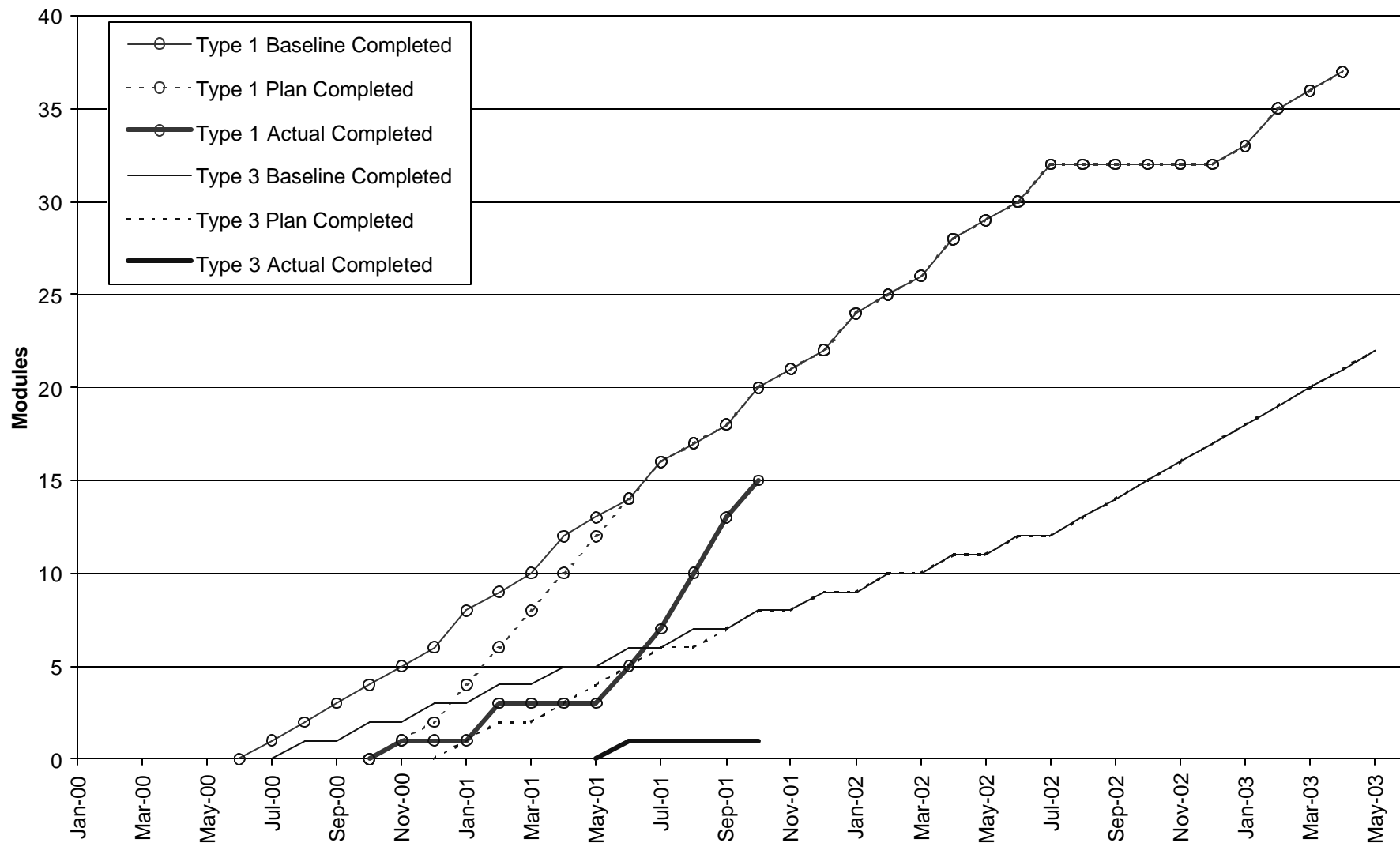


WBS 1.2.1 Barrel Mechanics																					
Line Of Balance Data																					
(All numbers are CUM complete numbers)																					
Month/	HV Plates			Straws	Straws				Wire	Wire	Other	Modules	Modules	Modules	Modules	Modules	Modules	Modules	Modules	Modules	Modules
Year	Type 1	Type 2	Type 3	from	from	Shells	Shells	Shells	Joints-1	Joints-2	Comp	Type 1	Type 2	Type 3	CUM	Type 1	Type 2	Type 3	CUM	CUM	CUM
				CERN	Hampton	Type 1	Type 2	Type 3	Singles	Doubles	Kits	Mech	Mech	Mech	Mech	Compl	Compl	Compl	Compl	Test	
Jan-00				2343					600/m	200/m											
Feb-00				2343																	
Mar-00				2343																	
Apr-00				2343					glass	glass											
May-00				2,343				1	1	0											
Jun-00				2,343				1	1	0											
Jul-00				5,243	520			3	4	0											
Aug-00				5,243	1,369		1	3	6	1											
Sep-00	1	2		5,243	1,369	1	2	4	8	1	1					glass	glass	glass			
Oct-00	2	4		7,243	3,011	2	4	5	10	2	3		1		1	0	1	1	0		
Nov-00	4	4	1	9,543	4,189	4	6	6	12	2	3	1	2		3	1	2	0			
Dec-00	4	4	1	11,843	6,500	6	8	7	14	4	6	1	2		3	1	2	0			
Jan-01	6	6	3	14,143	8,000	8	9	8	16	5	9	2	3	1	6	2	3	1			
Feb-01	8	8	3	16,443	10,000	10	11	9	19	6	12	4	4	1	9	4	4	1			
Mar-01	12	12	3	18,743	12,000	12	12	10	22	7	17	5	5	2	12	5	5	2			
Apr-01	14	14	3	21,043	11,718	14	14	10	25	9	21	7	7	3	17	7	7				
May-01	16	14	3	23,343	16,000	16	15	10	28	11	25	9	9	3	21	9	9				
Jun-01	17	14	3	25,643	18,200	17	17	10	32	13	27	11	11	3	25	11	11				
Jul-01	18	14	3	27,943	13,034	18	18	10	36		29	13	11	3	27	13					
Aug-01	20	14	3	30,243	23,000	20	19	10	40		31	15	11	3	29	15					
Sep-01	21	14	3	32,543	23,000	21	21	10			33	17	11	3	31						
Oct-01	21	14	3	32,108	24,000	22	22	10			33	19	11	3	33						
Nov-01	21	14	4	32,108	27,000	24	22	10			35	19	11	3	33						
Dec-01	24	16	6	35,977	31,000	25	22	10			45	21	11	3	35						
Jan-02	27	18	8	39,277	34,000	26	23	12			52	23	11	4	38						
Feb-02	30	20	11	42,577	37,600	28	25	14			60	25	11	5	41						
Mar-02	33	22	14	45,877	41,600	29	26	18			66	28	13	7	48						
Apr-02	36	24	17	49,177	45,000	30	27	20			71	31	15	10	56						
May-02	37	26	20	52,477	49,000	32	29	22	4600	600	76	32	18	14	64						
Jun-02		28	23	55,777	53,000	32	30	24	8800	1600	81	32	20	18	70	4	1	1	6	1	
Jul-02		30	26	59,077	56,600	32	31	26	13000	2600	86	32	22	22	76	8	3	2	13	3	
Aug-02		32	29	62,377	60,300	32	32	28	17200	3600	91	32	25	26	83	12	4	3	19	7	
Sep-02		34	32			32	32	30	21400	4600	95	32	27	30	89	16	6	4	26	11	
Oct-02		36	35			32	32	32	25600	5600	99	32	29	32	93	20	9	7	36	16	
Nov-02		37	37			33	32	34	29800	6600	103	32	32	32	96	24	13	9	46	22	
Dec-02						35	32	36	34000	7600	107					28	16	13	57	28	
Jan-03						36	33	37	38200	8600	110					32	20	17	69	34	
Feb-03						37	34		43400		111					32	23	22	77	40	
Mar-03							36		48600							32	27	26	85	46	
Apr-03							37		53800							32	30	31	93	52	
May-03									59000							32	32	32	96	58	
Jun-03																				64	
Jul-03																				70	
Aug-03																				76	
Sep-03																				82	
Oct-03																				88	
Nov-03																				94	
Dec-03																				96	
Jan-04																					
Feb-04																					



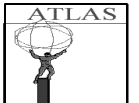
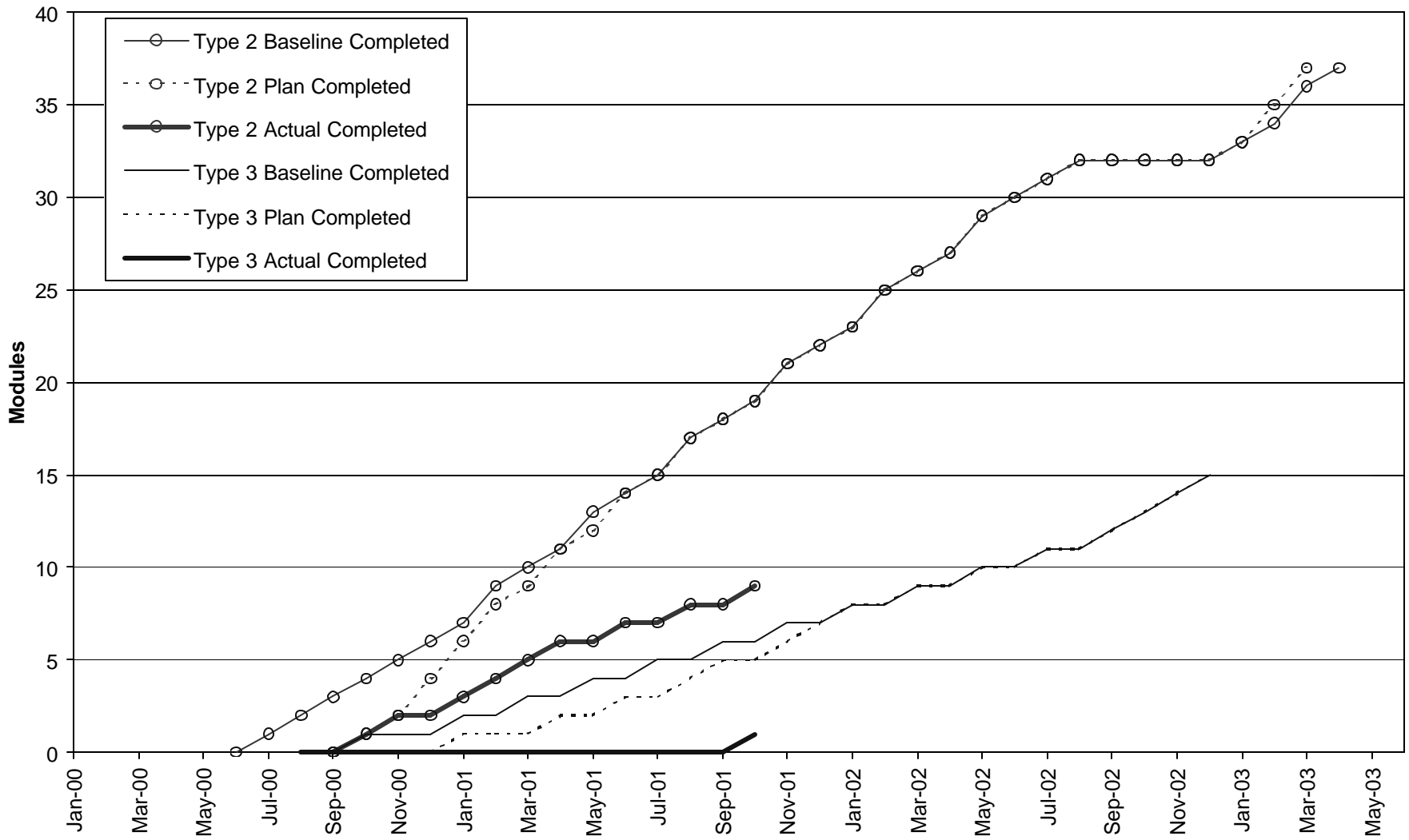
## Module Production - Indiana Facility-ETC01

### Line of Balance



## Module Production - Duke Facility-ETC01

### Line of Balance



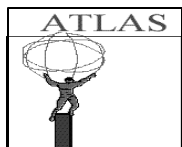
	HV Plates			Straws from CERN	Straws from Hampton	Shells Mod #1	Shells Mod #2	Shells Mod #3	Wire Joints-1 600/m	Wire Joints-2 200/m	Other Component Kits	Module #1 Assembly	Module #2 Assembly	Module #3 Assembly	CUM Modules	CUM Test
	Mod #1	Mod #2	Mod #3													
Jan-00				2343												
Feb-00				2343												
Mar-00				2343												
Apr-00				2343												
May-00			0	2,343				1	1	0	1					
Jun-00			0	2,343				1	1	0	1					
Jul-00			0	5,243	520			3	4	0	2					
Aug-00		1	0	5,243	1,369		1	3	6	1	2	0	0	0	0	
Sep-00	1	2	0	5,243	1,369	1	2	4	8	1	3	0	0	0	0	
Oct-00	2	4	0	7,243	3,011	2	4	5	10	2	5	0	1	0	1	
Nov-00	4	4	1	9,543	4,189	4	6	6	12	2	8	1	2	0	3	0
Dec-00	4	4	1	11,843	6,500	6	8	7	14	4	11	1	2	0	3	0
Jan-01	6	6	3	14,143	8,000	8	9	8	16	5	14	2	3	1	6	0
Feb-01	8	8	5	16,443	10,000	10	11	9	19	6	18	4	4	1	9	0
Mar-01	12	12	9	18,743	12,000	12	12	10	22	7	22	5	5	2	12	1
Apr-01	14	14	11	21,043	14,097	14	14	11	25	9	27	7	7	3	17	5
May-01	16	15	12	23,343	16,000	16	15	12	28	11	32	9	9	4	22	9
Jun-01	17	17	13	25,643	18,200	17	17	13	32	13	37	11	11	6	28	13
Jul-01	18	18	14	27,943	20,665	18	18	14	36	15	42	13	13	8	34	17
Aug-01	20	19	15	30,243	23,000	20	19	15	40	17	48	15	15	10	40	21
Sep-01	21	21	16	32,543	25,400	21	21	16	44	19	54	17	17	12	46	25
Oct-01	22	22	17	34,843	27,800	22	22	17	48	21	60	19	19	14	52	31
Nov-01	24	23	18	37,143	30,100	24	23	18	52	23	66	21	21	15	57	37
Dec-01	25	25	19	39,443	32,500	25	25	19	56	25	71	22	22	16	60	43
Jan-02	26	26	20	41,743	35,000	26	26	20	60	27	75	24	23	17	64	49
Feb-02	28	27	21	44,043	37,250	28	27	21	64	29	79	25	25	18	68	55
Mar-02	29	29	22	46,343	40,000	29	29	22	68	31	82	26	26	19	71	63
Apr-02	30	30	23	48,643	42,500	30	30	23	72	33	86	28	27	20	75	71
May-02	32	31	24	50,943	44,887	32	31	24	76	35	88	29	29	21	79	75
Jun-02	32	32	26	53,243	46,200	32	32	26	80	37	90	30	30	22	82	79
Jul-02	32	32	28	55,543	47,786	32	32	28	84		92	32	31	23	86	82
Aug-02	32	32	30	57,843	49,372	32	32	30	88		94	32	32	24	88	86
Sep-02	32	32	32	60,143	50,958	32	32	32	92		96	32	32	26	90	88
Oct-02	32	32	33		52,544	32	32	33	96		99	32	32	28	92	90
Nov-02	33	33	34		54,186	33	33	34	100		103	32	32	30	94	92
Dec-02	35	34	35		56,157	35	34	35	104		107	32	32	32	96	94
Jan-03	36	36	36		58,319	36	36	36	108		110	33	33	33	99	96
Feb-03	37	37	37		59,961	37	37	37	111		111	35	34	34	103	99
Mar-03					60,754							36	36	35	107	103
Apr-03												37	37	36	110	108
May-03												37	37	37	111	110
Jun-03																111



# TRT Milestones

## Level 2 Milestones

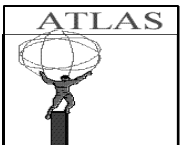
Subsystem	Schedule Designator	Description	ETC 01 Schedule Date	ETC 02 Schedule Date
TRT	TRT L2/1	Final Design Complete	Complete	Complete
	TRT L2/2	Module Production Complete (Cum 102)	31-Mar-03	1-May-03
	TRT L2/3	Barrel Construction Complete	16-Sep-03	16-Sep-03
	TRT L2/4	Select Final Elec Design	31-Aug-01	Complete
	TRT L2/5	Start Production of ASICS	18-Jan-02	9-Jul-02
	TRT L2/6	Installation Complete	4-Jan-05	4-Jan-05



# TRT Milestones

## Level 3 Milestones (Goals)

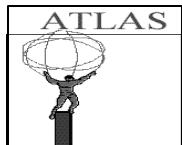
Subsystem	Schedule Designator	Description	ETC 01 Schedule Date	ETC 02 Schedule Date
TRT	TRT L3/1	Barrel Mechanics (Cum 102)	31-Mar-03	1-May-03
	TRT L3/2	ASDBLR	13-Dec-02	18-Mar-03
	TRT L3/3	PCB-Endcap	11-Apr-03	11-Apr-03



# TRT Milestones

## Level 4 Milestones (Baseline Scope)

WBS	Schedule Designator	U.S. ATLAS Responsibility Completion Description	ETC 01 Planned Completion Date	ETC 02 Baseline Scope Completion Date	ATLAS Required Date	ETC 02 Planned Float (Months)
<b>TRT</b>						
1.2.1	TRT L4/1	Barrel Modules Ship to CERN Compl (CUM 69)	8/02	6/03	7/03	1
1.2.5	TRT L4/2	ASDBLRs Ship to LUND Compl	10/02	12/02	6/03	6
	TRT L4/3	ASDBLRs Ship to CERN Compl	11/02	3/03	6/03	3
	TRT L4/4	PCB-Endcaps Ship to CERN Compl	4/03	4/03	7/03	3



# Assembly Schedule

ID	Task Name	Duration	Start	Finish	2002				2003				2004				2005	
					Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2
4	test modules	393 days	Tue 6/18/02	Thu 12/18/03														
5	modules at CERN	391 days	Wed 8/28/02	Wed 2/25/04														
6	Bldg 154 checks	393 days	Wed 8/28/02	Fri 2/27/04														
7	spaceframe assembly	44 days	Tue 2/18/03	Fri 4/18/03														
8	install barrel modules	306 days	Mon 4/21/03	Mon 6/21/04														
9	Barrel ready for SCT	0 days	Mon 6/21/04	Mon 6/21/04														
10	ID barrel ready for installation	0 days	Tue 2/15/05	Tue 2/15/05														



# ETC02 Cost Profile

## TRT – WBS Level 3

### TRT ETC 02 Access Profile (Project K\$s)

#### WBS

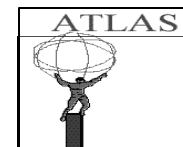
121 Barrel Mechanics

125 Electronics

1.2 Total (FY02\$s)

1.2 Total (AY\$s)

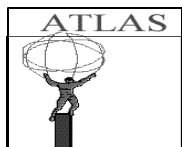
FY01	FY02	FY03	FY04	FY05	FY06	Total
	1,978.1	188.2				2,166.3
	1,268.0	225.7	183.6	102.1		1,779.3
0.0	3,246.1	413.9	183.6	102.1	0.0	3,945.6
0.0	3,246.1	425.5	194.0	111.0	0.0	3,976.5



# ETC02 Cost Comparison

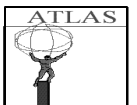
## TRT – WBS Level 3

(Project AYk\$s)			
	Baseline Budget (ETC01 FY02-FY05 + Carryover)	Final ETC02 (FY02-FY05)	
<b>WBS</b>	<b>Budget (AYk\$s)</b>	<b>ETC Budget (AY\$s)</b>	<b>Delta</b>
<b>121 Barrel Mechanics</b>	2,050.6	2,171.5	(120.9)
<b>125 Electronics</b>	1,684.9	1,806.0	(121.1)
<b>Total</b>	3,735.5	3,977.5	(242.0)



# WBS 1.2.1 Budget

- In Dec, 2001 the ETC02 was calculated to be \$2166K, assuming that we would have to adopt a new wire joint equivalent to the Polyimide solution with the schedules as shown previously- wire stringing until ~ May, 2003.
- This resulted in an increase in project costs of \$120K
- The new MC was estimate at \$778K, an increase of \$178K from ETC01



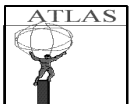
# Schedule, Budget

## Production rates

- ◆ Component production is now advanced enough to support the early completion of the mechanical construction of 96 module. Wire stringing at three sites, beginning this summer in June will allow the completion of 96 modules by May, 2003.

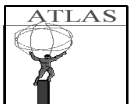
## Budget

The \$120K project funds added in ETC02. We need authorization to begin work on the final 30% of modules and Management Contingency of \$ 178K for assembly technicians in ~May to carry out the plan on schedule.



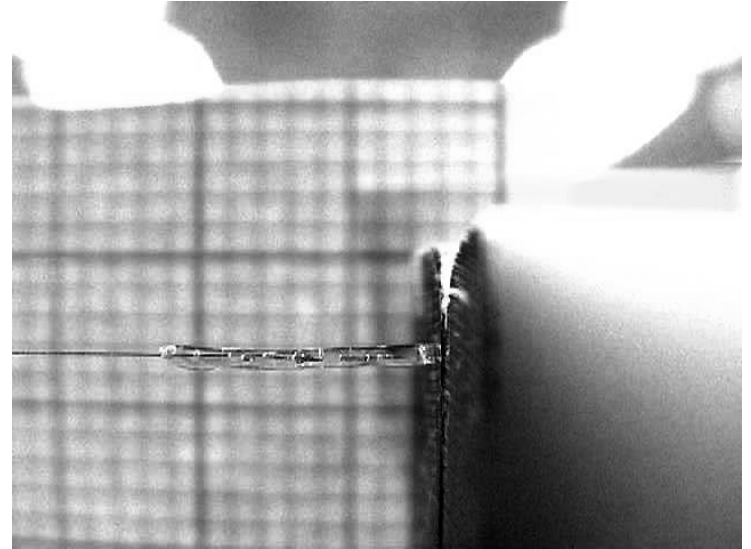
# Wire joint tests

- **Tests of alternate wire joints**
  - ◆ Encapsulated glass
  - ◆ Peek
  - ◆ Polyimide
- **Binary gas studies**

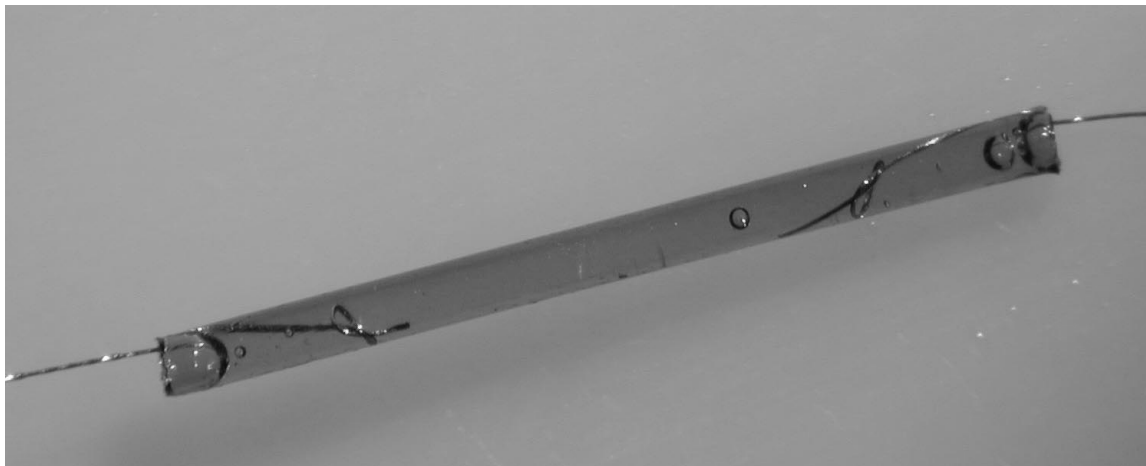


# Wire Joint replacement

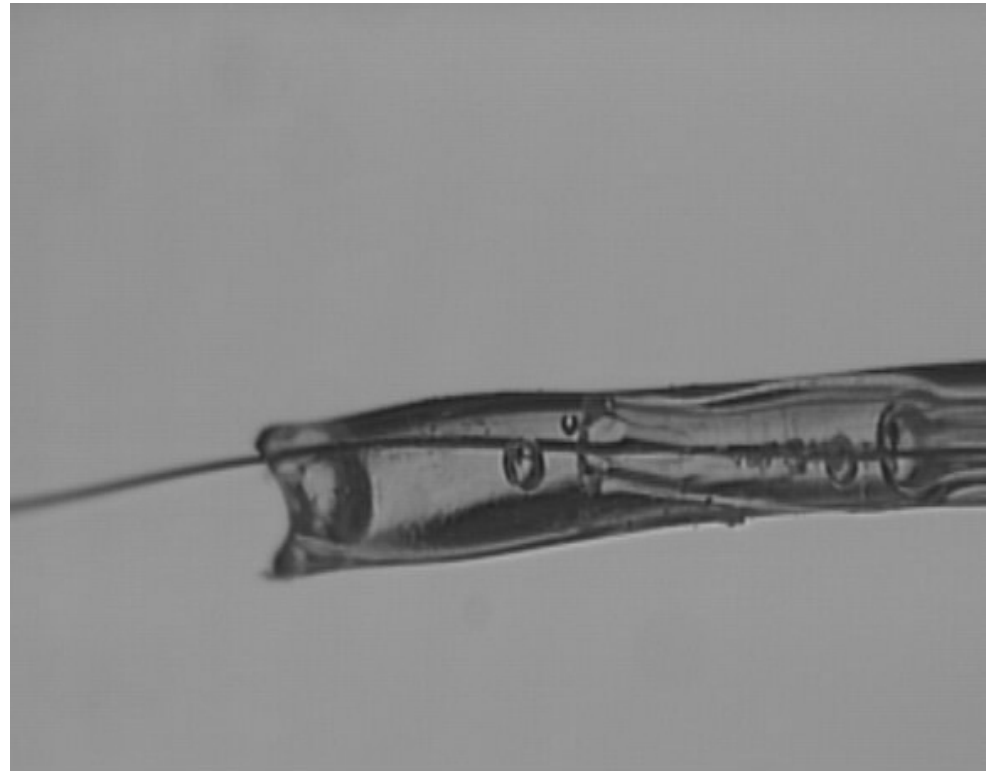
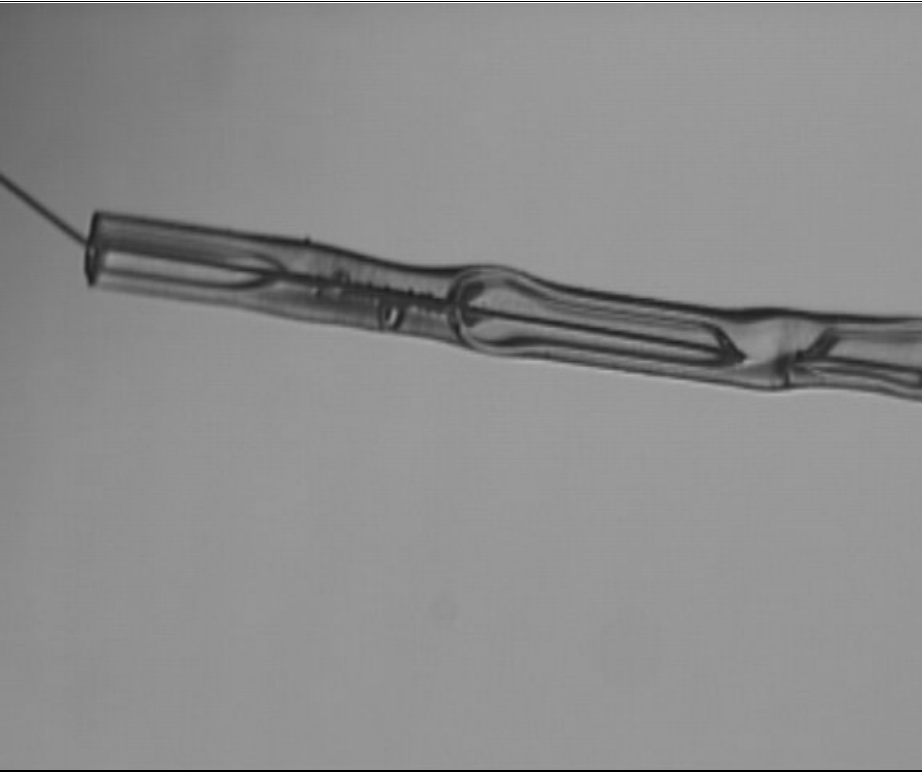
**The strategy adopted is to validate three alternate wire-joint implementations by March 25, 2002, using the standard gas mixture (with CF<sub>4</sub>) at high and low dose rates in parallel (to look at integral dose of at least 2 C/cm and nominal LHC rates)**



# Kapton/epoxy, Peek wire-joint



# Encapsulated Glass



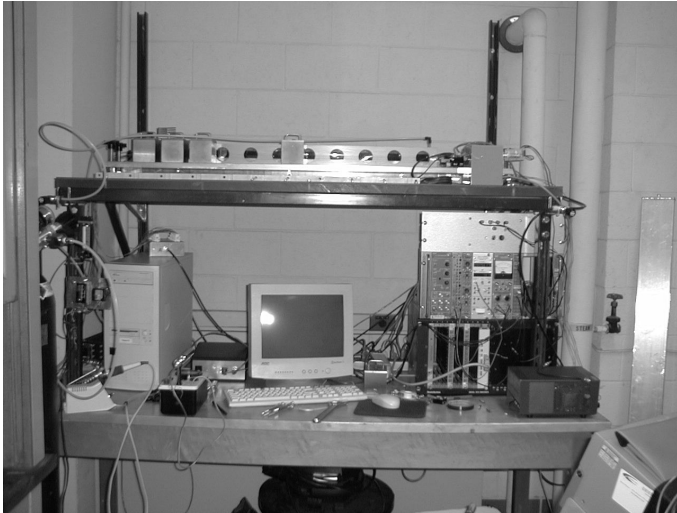
# Irradiation test facility at Duke

- Radiation ( $\text{SR}^{90}$ ) Ten 10 milli-curie, Eight 10 milli-curie+ two 50 milli-curie

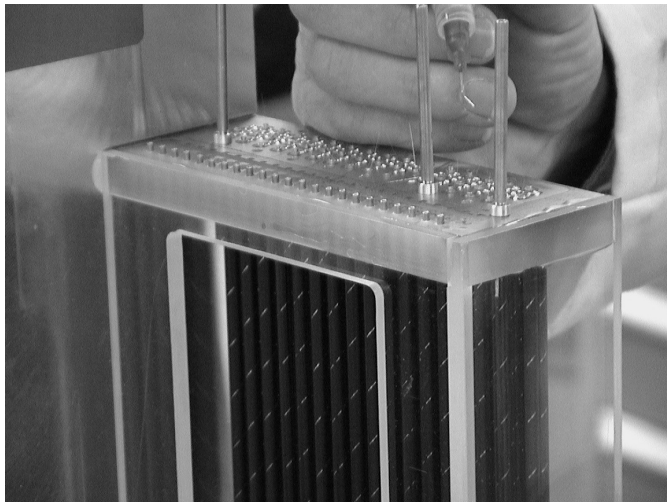
Xe/CO<sub>2</sub>/CF<sub>4</sub> and Xe/Co<sub>2</sub>/CF<sub>4</sub> irradiation about 0.15 – 0.2  $\mu\text{amp/cm}$



# Wire Joint Testing

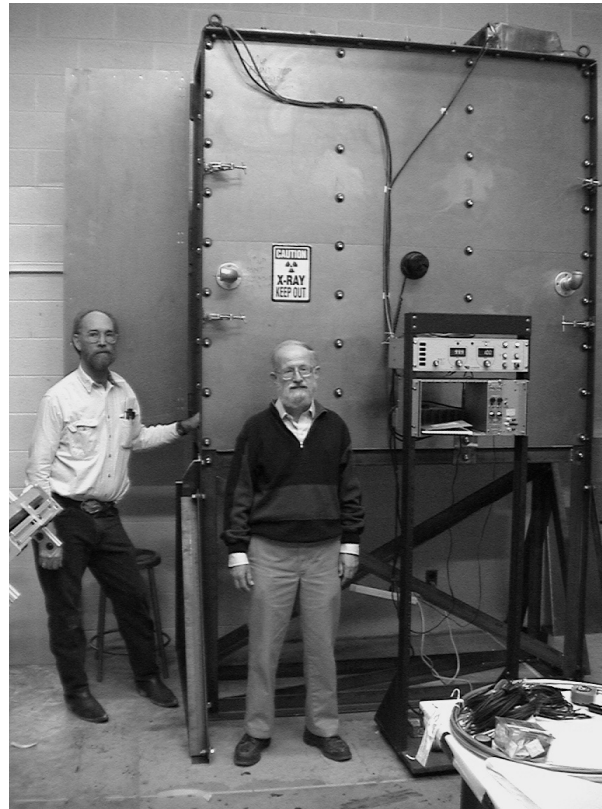


Sr-90 irradiation test- Duke University



Duke designed - wire test stand

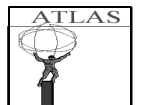
- Both Duke and Indiana are involved in the prototyping evaluation of the wire-joint production process
- Both are working on validation of the joint in a high current straw test.



X-ray cabinet-  
Indiana University

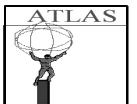
Currents of 1-2  
microamps/cm at  
nominal wire gain.  
With Xe/Co2/CF4  
And Xe/C02

BNL March 22, 2002



# Binary Gas option

- Detailed review of performance of binary gas in straw trt system is underway.
- March 25. An alternate wire joint will be chosen or the TRT will actively pursue changing the gas to a binary mixture.
- May 24. Decision to begin restringing. If Binary gas option, this could be delayed several months from the June start up planned for new joints.



# Conclusion

- **Wire stringing has been halted for the past 5 months.**
- **Mechanical assembly has been accelerated.**
- **In the event that a new wire joint is chosen or binary gas is used we should be able to complete the 96 module production in May, 2003- about a 5 month delay from ETC01. This will not impact ATLAS installation.**

